CERTIFICATE OF TRANSLATION

As a below named translator, I hereby declare that my residence and citizenship are as stated below next to my name and I hereby certify that I am conversant with both the English and Korean languages and the document enclosed herewith is a true English translation of the Priority Document with respect to the Korean patent application No. **1999-37496** filed on **August 30, 1999.**

NAME OF THE TRANSLATOR : Sook-Hee KIM

SIGNATURE : Sook Hee Kim

Date : January 11, 2005

RESIDENCE : MIHWA BLDG., 110-2, MYONGRYUN-DONG 4-GA, CHONGRO-GU, SEOUL 110-524, KOREA

CITIZENSHIP : REPUBLIC OF KOREA

Translation of Priority Document

THE KOREAN INTELLECTUAL PROPERTY OFFICE

This is to certify that annexed hereto is a true copy from the records of the Korean Intellectual property Office of the following application as filed.

Application Number : Korean Patent Application No. 1999-37496

Date of Application : August 30, 1999

Applicant(s) : Samsung Electronics Co., Ltd.

January 11, 2005

COMMISSIONER

[SPECIFICATION]

[TITLE OF THE INVENTION]

APPARATUS AND METHOD FOR CONTROLLING DEMULTIPLEXER AND MULTIPLEXER FOR RATE MATCHING IN RADIO COMMUNICATION SYSTEM

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 is a block diagram of an uplink transmitting device in a general radio communication system.

FIG. 2 is a block diagram of an uplink transmitting device provided with a DEMUX and a MUX for rate matching, to which the present invention is applied.

FIG. 3 illustrates an example of turbo encoder input and the turbo encoder output in the uplink transmitting device of FIG. 2.

FIG. 4 illustrates an example of 1^{st}-interleaver input in the uplink transmitting device of FIG. 2.

FIGs. 5A, 5B, and 5C illustrate examples of 1^{st}-interleaver output in the uplink transmitting device of FIG. 2.

FIGs. 6A to 6D illustrate examples of radio frame segmenter output in the uplink transmitting device of FIG. 2.

FIGs. 7A, 7B, and 7C illustrate 1^{st}-interleaver input, 1^{st}-interleaver output, and radio frame segmenter output according to embodiment 1-1 of the present invention.

FIGs. 8A, 8B, and 8C illustrate 1^{st}-interleaver input, 1^{st}-interleaver output, and radio frame segmenter output according to embodiment 1-2 of the present invention.

FIGs. 9A to 9D illustrate 1st-interleaver input, 1st-interleaver output, and radio frame segmenter output according to embodiment 2 of the present invention.

FIGs. 10A, 10B, and 10C illustrate 1st-interleaver input, 1st-interleaver output, and radio frame segmenter output according to embodiment 3 of the present invention.

FIG. 11 is a block diagram of an embodiment of a DEMUX & MUX controlling apparatus according to the present invention.

FIG. 12 is a block diagram of another embodiment of the DEMUX & MUX controlling apparatus according to the present invention.

FIG. 13 is a block diagram of a third embodiment of the DEMUX & MUX controlling apparatus according to the present invention.

[DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT]

[OBJECT OF THE INVENTION]

[RELATED FIELD AND PRIOR ART OF THE INVENTION]

The present invention relates generally to rate matching of a channel encoded signal in a radio communication system, and in particular, to an apparatus and method for controlling a demultiplexer (DEMUX) and a multiplexer (MUX) used for rate matching.

In general, radio communication systems channel-encode source user data with an error correction code prior to transmission, such as a satellite system, ISDN (Integrated Services Digital Network), a digital cellular system, W-CDMA (Wide-band Code Division Multiple Access), UMTS (Universal Mobile Telecommunication System), and IMT (International Mobile Telecommunication)-2000, in order to increase system reliability. Typical codes used for channel encoding are a convolutional code and a linear block code for

which a single decoder is used. A turbo code useful for data transmission/reception has been additionally suggested of late.

A multiple-access and multiple-channel communication system matches the number of channel-encoded symbols to a given number to increase data transmission efficiency and system performance. This operation is called rate matching. Puncturing and repetition are widely performed to match the data rate of channel-encoded symbols. The rate matching has recently emerged as a significant issue to the UMTS to increase data transmission efficiency in the air interface and improve system performance.

FIG. 1 is a block diagram of an uplink transmitting device in a general radio communication system (the UMTS, herein).

Referring to FIG. 1, a channel encoder 110 receives frame data at every predetermined TTIs (Transmission Time Intervals). The TTI may be 10, 20, 40, or 80ms. A 1st interleaver 120 interleaves the output of the channel encoder 110. A radio frame segmenter 130 segments interleaved frames received from the 1st interleaver 120 into 10-ms radio frame blocks. A rate matcher 140 matches the data rate of a radio frame received from the radio frame segmenter 130 to a preset data rate by puncturing or repeating symbols of the radio frame. The above-described components can be provided for each service.

A MUX 150 multiplexes rate-matched radio frames for each service. A physical channel segmenter 160 segments the multiplexed radio frames received from the MUX 150 into physical channel blocks. A 2nd interleaver 170 interleaves the physical channel blocks received from the MUX 150. A physical channel mapper 180 maps the 2nd-interleaved blocks on physical channels for

transmission.

As shown in FIG. 1, the UMTS uplink transmitting device is provided with the rate matcher 140. The rate matcher 140 varies in configuration depending on whether the channel encoder 110 is a convolutional encoder or a turbo encoder. When a turbo encoder is used as the channel encoder 110, the rate matcher 140 is so constituted as to include a DEMUX 141, component rate matchers 142, 143, and 144, and a MUX 145, as shown in FIG. 2. The DEMUX 141 separates each radio frame received from the radio frame segmenter 130 into information symbols and parity symbols and switches them to the corresponding component rate matchers 142, 143, and 144. The MUX 145 multiplexes symbols received from the component rate matchers 142, 143, and 144 and feeds the multiplexed symbols to the MUX 150 of FIG. 1.

The uplink transmitting device shown in FIG. 2 is so constituted that the systematic information part of encoded symbols is not punctured in view of the nature of a turbo code being a systematic code. It is preferred that two component encoders are connected in parallel in the turbo encoder and the minimum free distance between final codes maximizes that of each component encoder. To do so, the consideration that best performance can be achieved by equal puncturing of the output symbols of the two component encoders is reflected in the constitution of the uplink transmitting device.

As illustrated above, it is preferred that the DEMUX 141 is located between a radio frame segmenter and rate matchers, and the MUX 145 between the rate matchers and the MUX 150 in the uplink transmitting device of general radio communication systems such as the UMTS, when rate-matching turbo-encoded signals. However, a method and operation of controlling the MUX and

the DEMUX has not defined as yet.

[SUBSTANTIAL MATTER OF THE INVENTION]

It is, therefore, an object of the present invention to provide an apparatus and method for controlling a DEMUX and a MUX for use in rate matching in an uplink transmitting device of a radio communication system.

It is another object of the present invention to provide an apparatus and method for controlling a DEMUX and a MUX for use in rate matching of a turbo-encoded signal in an uplink transmitting device of a radio communication system.

To achieve the above objects, there is provided an apparatus and method for controlling a demultiplexer and multiplexer provided for rate matching in a radio communication system. An uplink transmitter according to the present invention comprises: a turbo encoder for turbo-encoding data for transmission and outputting encoded symbols; an interleaver for interleaving the encoded symbols; a radio frame segmenter for segmenting the interleaved symbols into radio frames of a predetermined unit; a demultiplexer for demultiplexing the radio frames according to a predetermined rule; rate matchers for rate-matching radio frames separately outputted from the delultiplexer and outputting rate-matched frames; and a multiplexer for multiplexing an output of the rate matchers according to the predetermined rule and outputting a multiplexed frame. The above rule is determined based on an initial component value of a present frame outputted from the radio frame segmenter and a repeating pattern determined by a transmission time unit.

[CONSTRUCTION AND OPERATION OF THE INVENTION]

A preferred embodiment of the present invention will be described herein below with reference to the accompanying drawings, wherein like numbers designate like objects. In the following description, well-known functions or constructions are not described in detail since they would obscure the invention in unnecessary detail.

The present inventor makes it clear that each component of the uplink transmitting device shown in FIG. 2 operates in connection with control of the DEMUX 141 and MUX 145 for rate matching. The properties of the respective components of the uplink transmitting device are as follows.

A turbo code used in the turbo encoder 110 of FIG. 2 is a systematic code that can be separated into a systematic information symbol part Xk and parity symbol parts Yk and Zk. For the turbo encoder 110, R = 1/3. Hereinafter, the systematic information symbol part will be labeled with x and the parity symbol parts with y and z. When R = 1/3, the relationship between the input and output of the turbo encoder 110 is shown in FIG. 3.

Referring to FIG. 3, the turbo encoder output is a sequence of an information symbol part x1, a primary parity symbol part y1, an information symbol part x2, a primary parity symbol part y2, a secondary parity symbol part z2, an information symbol part x3, a primary parity symbol part y3, a secondary parity symbol part z3, ... in this order.

The 1st interleaver 120 interleaves encoded symbols according to a TTI (Transmission Time Interval) and the number of the input symbols. The

interleaving can be considered in two steps.

First Step

1. The total number of columns is determined referring to Table 1 shown below.

2. A minimum integer R_1 is found in an equation given by

$$K_1 \Leftarrow R_1 \underline{x} \ C_1 \qquad \ldots\ldots (1)$$

where R_1 is the number of rows and K_1 is the length of an input block.

3. The 1st-interleaver input sequence is arranged by rows in an rectangular array having R_1 rows and C_1 columns.

Second Step

1. Columns are reordered according to an inter-column permutation pattern $\{P_1(j)\}$ ($j = 0, 1, \ldots, C-1$) shown in Table 1. $P_1(j)$ represents the original column of a j^{th} permuted column.

2. The 1st-interleaver output is a sequence resulted from reading the permuted $R_1 \times C_1$ array by columns. Bits that do not exist in the 1st-interleaver input are excluded from outputting by eliminating I_1 defined as

$$I_1 = R_1 \cdot C_1 - K_1 \qquad \ldots\ldots (2)$$

(Table 1)

TTI	total number of columns	inter-column permutation patterns
10ms	1	{0}
20ms	2	{0, 1}
40ms	4	{0, 2, 1, 3}
80ms	8	{0, 4, 2, 6, 1, 5, 3, 7}

By interleaving using Eqs. 1 and 2, the 1st interleaver 120 outputs interleaved symbols in the same pattern as a turbo encoder output pattern, that is, in the pattern of x, y, z, x, y, z, ... (or x, z, y, x, z, y, ... with parity symbol parts z and y exchanged in position).

FIG. 4 illustrates an example of 1st-interleaver input after turbo-encoding 160 input bits at R = 1/3. When TTI = 10ms, the 1st-interleaver input and the 1st-interleaver output are identical. In FIG. 4, a blank rectangle denotes a system information symbol part x, a rectangle marked with slant lines denotes a primary parity symbol part y, and a rectangle marked black denotes a secondary parity symbol part z.

In FIG. 4, the 1st interleaver 120 sequentially receives code symbols 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, ..., 160 from the turbo encoder 110. Each number represents an encoded symbol received from the turbo encoder 110. In view of the nature of a turbo code, the 1st-interleaver input follows the pattern of x, y, z, x, y, z, x, y, z, ...

FIG. 5A illustrates an example of 1st-interleaver output when R = 1/3 and TTI = 20ms.

Referring to FIG. 5A, the 1st-interleaver output sequence is 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, ..., 160 in an interleaved order in the pattern of x, z, y, x, z, y, x, z, y, ...

FIG. 5B illustrates an example of 1st-interleaver output when R = 1/3 and TTI = 40ms.

Referring to FIG. 5B, the 1st-interleaver output sequence is 1, 5, 9, 13, 17, 21, 25, 29, 33, ..., 160 in an interleaved order in the pattern of x, y, z, x, y, z, x, y, z ....

FIG. 5C illustrates an example of 1st-interleaver output when R = 1/3 and TTI = 80ms.

Referring to FIG. 5C, the 1st-interleaver output sequence is 1, 9, 17, 25, 33, 41, 49, 57, 65, ..., 160 in an interleaved order in the pattern of x, z, y, x, z, y, x, z, y ....

The interleaver outputs shown in FIGs. 4, 5A, 5B, and 5C are given on the assumption that an interleaver size (= 120) is an integer multiple of TTI/10ms (= 1, 2, 4, or 8). In case an interleaver size is not an integer multiple of TTI/10ms, a different 1st-interleaver output is produced.

The radio frame segmenter 130 of FIG. 2 segments a frame of 10, 20, 40, or 80ms into 10-ms radio frame blocks. Because the ratio (L/T) of an input frame size (L) to the TTI (T) of an input frame is not always an integer, the number (r) of filler bits is calculated by Eq. 3 to compensate for L/T with the filler bits. Here, T ranges from 0 to 8. Then, r is between 0 and 7. (L+r)/T resulted from the compensation is defined as R.

$$r = T - (L \bmod T) \qquad \ldots\ldots (3)$$

where $r \in \{0, 1, 2, 3, 4, 5, 6, 7\}$.

$$Ri = (Li + ri)/Ti \qquad \ldots\ldots (4)$$

If r is not 0, the radio frame segmenter 130 inserts a filler bit into the last bit position of a corresponding frame from a $(T-r+1)^{th}$ radio frame in order to maintain a frame size to be R. The filler bit is arbitrarily chosen between 0 and 1. Now a description will be made of the bit-basis operation of the radio frame segmenter 130.

For description of bits prior to processing in the radio frame segmenter 130, it is assumed that the number r of filler bits has been calculated. Here, t represents the index of a radio frame, ranging from 1 through T ($1 \leq t \leq T$). t = 1 for the first radio frame, t = 2 for the second radio frame, and similarly, t = T for the last radio frame. Each radio frame is the same size (L+r)/T. It is assumed that the 1st-interleaver output is $b_1, b_2, \ldots, b_L$, $T(TTI/10ms) \in \{1, 2, 4, 8\}$, and the radio frame segmenter output symbols are $c_1, c_2, \ldots, c_{(L+r)/T}$ in a 10-ms frame. Then,

(Table 2)

output symbols of the radio frame segmenter for the first 10msec: t = 1

$$c_j = b_j \qquad j = 1, 2, \ldots, (L+r)/T$$

output symbols of the radio frame segmenter for the second 10msec: t = 2

$$c_j = b_{(j+(L+r)/T} \qquad j = 1, 2, \ldots, (L+r)/T$$

:

output symbols of the radio frame segmenter for the $(T-r)^{th}$ 10msec: t = (T−r)

$$c_j = b_{(j+(T-r-1)(L+r)/T)} \qquad j = 1, 2, \ldots, (L+r)/T$$

output symbols of the radio frame segmenter for the $(T-r+1)^{th}$ 10msec: $t = (T-r+1)^{th}$

$$c_j = b_{(j+(T-r)(L+r)/T)} \qquad j = 1, 2, \ldots, (L+r)/T-1$$

$$c_j = \text{filler\_bit } (0/1) \qquad j = (L+r)/T$$

:

output bits of the radio frame segmenter for the T^{th} 10msec: t = T $c_j = b_{(j+(T-1)(L+r)/T)}$ $\quad$ $j = 1, 2, \ldots, (L+r)/T-1$ c_j = filler_bit (0/1) $\quad$ $j = (L+r)/T$

The purpose of using the component rate matchers 142, 143, and 144 of FIG. 2 is to increase the data transmission efficiency of a channel encoding technique and improve system performance in a multiple-access/multiple-channel system using the above-described channel encoding mechanism. Rate matching refers to control of input bit number to output bit number through puncturing when the input size is larger than the output size or repetition when the input size is smaller than the output size. The symbol puncturing or repetition is generally performed periodically but the followings should be considered for rate matching when a turbo code is used.

1. Because the turbo code is a systematic code, a systematic information symbol part of encoded symbols should be excluded from puncturing.

2. The minimum free distance between final codes preferably maximizes that of each component encoder since two component encoders are connected in parallel in a turbo encoder due to the nature of the turbo code. Therefore, the output symbols of the two component encoders should be equally punctured to achieve optimal performance.

In the rate matching structure shown in FIG. 2, rate matching is implemented separately for each component. The first, second, and third component rate matchers 142, 143, and 144 subject an information symbol part x, a primary parity symbol part y, and a secondary parity symbol part z, respectively, to rate matching. Given input and output sizes for rate matching of each

component, each rate matcher performs puncturing/repetition on a predetermined number of symbols. This rate matching structure is built on the assumption that the DEMUX 141 outputs x, y, z, separately. Hence, the DEMUX 141 should be able to separate a radio frame received from the radio frame segmenter 130 into components x, y, z. in a certain order

There will be given a description of radio frame output patterns of the radio frame segmenter 130. Radio frames are read down by columns and each column corresponds to a radio frame.

FIG. 6A illustrates an output pattern of the radio frame segmenter 130 when TTI = 10ms.

Referring to FIG. 6A, a radio frame output pattern is identical to a radio frame input pattern, that is, x, y, z, x, y, z, ...

FIG. 6B illustrates an output pattern of the radio frame segmenter 130 when TTI = 20ms.

Referring to FIG. 6B, a first radio frame RF #1 is output in the pattern of x, z, y, x, z, y, ... and a second radio frame RF #2 is output in a radio frame input pattern, that is, y, x, z, y, x, z, ...

FIG. 6C illustrates an output pattern of the radio frame segmenter 130 when TTI = 40ms.

Referring to FIG. 6C, a first radio frame RF #1 is output in the pattern of x, y, z, x, y, z, ..., a second radio frame RF #2 in the pattern of z, x, y, z, x, y, ..., a

third radio frame RF #3 in the pattern of y, z, x, y, z, x, ..., and a fourth radio frame RF #4 in the pattern of x, y, z, x, y, z, ...

FIG. 6D illustrates an output pattern of the radio frame segmenter 130 when TTI = 80ms.

Referring to FIG. 6D, a first radio frame RF #1 is output in the pattern of x, z, y, x, z, y, ..., a second radio frame RF #2 in the pattern of y, x, z, y, x, z, ..., a third radio frame RF #3 in the pattern of z, y, x, z, y, x, ..., a fourth radio frame RF #4 in the pattern of x, z, y, x, z, y, ..., a fifth radio frame RF #5 in the pattern of y, x, z, y, x, z, ..., a sixth radio frame #6 in the pattern of z, y, x, z, y, x, a seventh radio frame RF #7 in the pattern of x, z, y, x, z, y, ..., and an eighth radio frame RF #8 in the pattern of y, x, z, y, x, z, ...

Output patterns of the radio frame segmenter 130 have a certain regularity. Each radio frame pattern with the same TTI has a different initial component x, y, or z but has the same component repeating pattern. For TTIs = 10ms and 40ms, component are repeated in the pattern of x, y, z, x, y, z, ..., and for TTIs = 20ms and 80ms, components are repeated in the pattern of x, z, y, x, z, y, ...

Each radio frame is free of a filler bit in the above cases. That is, an input size is an integer multiple of TTI/10ms. When filler bits are to be inserted, radio frames have different patterns from the above-described patterns. Embodiment 1 through embodiment 3 as described below pertain to insertion of filler bits.

(Embodiment 1)

Embodiment 1-1

FIGs. 7A, 7B, and 7C illustrate 1st-interleaver input, 1st-interleaver output, and radio frame segmenter output according to embodiment 1-1 of the present invention.

If the input of the 1st interleaver 120 for TTI = 80ms is given in FIG. 7A, it is interleaved by columns according to an interleaving rule of the 1st interleaver 120, as shown in FIG. 7B. Then, symbols are read down from the left to the right column in the array of FIG. 7B. The resulting 1st-interleaver output (i.e, the radio segmenter input) is x, z, y, x, z, y, x, z, y, z, y, x, z, y, x, z, y, x, y, x, z, y, x, z, y, x, z, x, z, y, x, z, y, x, z, y. The output of the radio frame segmenter 130 is resulted from adding filler bits to the radio frame segmenter input.

In embodiment 1-1, filler bits are 0s. Symbols in the array of FIG. 7C are read column by column and each column represents one radio frame. As shown in FIG. 7C, each radio frame has a different initial component but follows the same component repeating pattern of x, z, y, ... That is, the radio frames have different initial components in the filler bit inserting case, as compared to the filler bit-free case.

Although filler bits are inserted, radio frames may have the same initial components as those in the filler bit-free case. An example of such a case using three filler bits for TTI = 40ms will be described.

Embodiment 1-2

FIGs. 8A and 8B illustrate 1st-interleaver input, 1st-interleaver output, and radio frame segmenter output according to embodiment 1-2.

If the input of the 1^{st} interleaver 120 for TTI = 40ms is given in FIG. 8A, it is interleaved by columns according to an interleaving rule of the 1^{st} interleaver 120 as shown in FIG. 8B. The resulting 1^{st}-interleaver output (i.e, the radio segmenter input) is x, y, z, x, y, z, z, x, y, z, x, y, z, x, y, z, x, y, z, x, y. The output of the radio frame segmenter 130 shown in FIG. 8C is resulted from adding filler bits to the radio frame segmenter input.

In embodiment 1-2, filler bits are 0s. Symbols in the array of FIG. 8C are read column by column and each column represents one radio frame. As shown in FIG. 8C, each radio frame has a different initial component but follows the same component repetition pattern of x, z, y, ... That is, the radio frames have the same initial components in this filler bit inserting case as those in the filler bit-free case.

The initial component of each radio frame is determined by a TTI and the number of filler bits added by the radio frame segmenter 130. Hereinbelow, initial components in all possible cases will be described. Tables 3 to 6 list initial components for TTIs = 10, 20, 40, and 80ms, respectively, when the radio frame segmenter 130 outputs radio frames RF#1, RF #2, RF #3, RF #4, RF #5, RF #6, RF #7, and RF #8 sequentially.

(Table 3)

TTI = 10ms

Total number of filler bits	initial component of
	RF #1
0	x

(Table 4)

TTI = 20ms

total number of filler bits	initial component of	
	RF #1	RF #2
0, 1	x	y

In Table 4, since the 1st interleaver 120 leaves the columns intact, positions are not changed when one filler bit is used. Consequently, the initial components are the same as those in the filler bit-free case.

(Table 5)

TTI = 40ms

Total number of filler bits	initial component of			
	RF #1	RF #2	RF #3	RF #4
0, 1, 3	x	z	y	x
2	x	z	z	x

When one or three filler bits are used, the number of symbols in each column before interleaving is equal to that of symbols in the column of the same index after interleaving, as shown in embodiment 1-2. Therefore, the initial components are the same as those in the filler bit-free case. If two filler bits are used, the number of symbols in each column before interleaving is different from that of symbols in the column of the same index after interleaving, as shown in embodiment 1-1. Therefore, the initial components are different from those in the filler bit-free case.

(Table 6)

TTI = 80ms

total number	initial component of

of filler bits	RF #1	RF #2	RF #3	RF #4	RF #5	RF #6	RF #7	RF #8
0, 1, 7	x	y	Z	x	y	z	x	y
2, 3	x	y	Z	x	x	y	z	y
4	x	y	Y	z	z	y	z	y
5, 6	x	y	Y	z	x	z	x	y

When one or seven filler bits are used, the number of symbols in each column before interleaving is equal to that of symbols in the column of the same index after interleaving, as shown in embodiment 1-2. Therefore, the initial components are the same as those in the filler bit-free case. If two, three, four, five, or six filler bits are used, the number of symbols in each column before interleaving is different from that of symbols in the column of the same index after interleaving, as shown in embodiment 1-1. Therefore, the initial components are different from those in the filler bit-free case.

As noted from the above tables, components are repeated in the pattern of x, y, z, x, y, z, for TTIs = 10ms and 40ms, whereas components are repeated in the pattern of x, z, y, x, z, y, for TTIs = 20ms and 80ms.

Therefore, given a TTI and the number of filler bits to be inserted by the radio frame segmenter 130, the DEMUX 141 demultiplexes 1st-interleaver output in the above-described manner.

(Embodiment 2)

FIGs. 9A to 9D illustrate 1st-interleaver input, 1st-interleaver output, and radio frame segmenter output according to embodiment 2 of the present invention. Embodiment 2 is different from embodiment 1 in that filler bits are inserted by the 1st interleaver 120 instead of the radio frame segmenter 130. In terms of

initial components and repeating patterns, this case is the same as the typical filler bit-free case.

If the input of the 1st interleaver 120 for TTI = 80ms is given in FIG. 9A, it is interleaved by columns according to an interleaving rule of the 1st interleaver 120 as shown in FIG. 9B. Then, filler bits are inserted to the array of FIG. 9B as shown in FIG. 9C. Here, the filler bits are 0s. Therefore, the 1st-interleaver output, i.e., the radio frame segmenter input is a sequence of x, z, y, x, z, y, z, y, 0, z, y, x, z, y, x, z, y, x, 0, y, x, z, y, x, z, y, x, z, 0, x, z, y, x, z, y, x, z, y, 0. The output of the radio frame segmenter 130 is shown in FIG. 9D.

The symbols in the array of FIG. 9D are read down by column after column and each column is a radio frame. As shown in FIG. 9D, each radio frame follows the same repeating pattern of x, z, y with a different initial component. As noted from FIGs. 9A to 9D, the initial components are the same as those in the general filler bit-free case.

The initial component of each radio frame is determined by a TTI. Tables 7 to 10 list initial components for TTIs = 10, 20, 40, and 80ms, respectively, when the radio frame segmenter 130 outputs radio frames RF#1, RF #2, RF #3, RF #4, RF #5, RF #6, RF #7, and RF #8 sequentially.

(Table 7)

TTI = 10ms

initial component of
RF #1
X

(Table 8)

TTI = 20ms

initial component of	
RF #1	RF #2
x	Y

(Table 9)

TTI = 40ms

initial component			
RF #1	RF #2	RF #3	RF #4
X	z	y	x

(Table 10)

TTI = 80ms

initial component of							
RF #1	RF #2	RF #3	RF #4	RF #5	RF #6	RF #7	RF #8
X	y	z	x	y	z	x	y

As noted from the above tables, components are repeated in the pattern of x, y, z, x, y, z, for TTIs = 10ms and 40ms, whereas components are repeated in the pattern of x, z, y, x, z, y, for TTIs = 20ms and 80ms.

Therefore, given a TTI, the DEMUX 141 demultiplexes 1^{st}-interleaver output in the above-described manner.

(Embodiment 3)

FIGs. 10A, 10B, and 10C illustrate 1^{st}-interleaver input, 1^{st}-interleaver output, and radio frame segmenter output according to embodiment 3 of the

present invention. Embodiment 3 is different from embodiment 1 in that the 1st interleaver 120 designates filler bit insertion positions and the radio frame segmenter 130 inserts the filler bits in the designated positions. In terms of initial components and repeating patterns, this case is the same as the typical filler bit-free case.

If the input of the 1st interleaver 120 for TTI = 80ms is given in FIG. 10A, it is interleaved by columns according to an interleaving rule of the 1st interleaver 120 as shown in FIG. 10B. Therefore, the 1st-interleaver output, i.e., the radio frame segmenter input is a sequence of x, z, y, x, z, y, x, z, y, z, y, x, z, y, x, z, y, x, y, x, z, y, x, z, y, x, z, x, z, y, x, z, y, x, z, y. The 1st interleaver 120 designates filler bit insertion positions and then the radio frame segmenter 130 inserts the filler bits in the designated positions as shown in FIG. 10C.

In this embodiment, the filler bits are 0s. The symbols in the array of FIG. 10C are read down by column after column and each column is a radio frame. As shown in FIG. 10C, each radio frame follows the same repeating pattern of x, z, y with a different initial component. As noted from FIGs. 10A, 10B, and 10C, initial components are the same as those in the general filler bit-free case.

The initial component of each radio frame is determined by a TTI. Tables 11 to 14 list initial components for TTIs = 10, 20, 40, and 80ms, respectively, when the radio frame segmenter 130 outputs radio frames RF#1, RF #2, RF #3, RF #4, RF #5, RF #6, RF #7, and RF #8 sequentially.

(Table 11)

TTI = 10ms

initial component of
RF #1
x

(Table 12)

TTI = 20ms

initial component of	
RF #1	RF #2
x	y

(Table 13)

TTI = 40ms

initial component			
RF #1	RF #2	RF #3	RF #4
X	z	y	x

(Table 14)

TTI = 80ms

initial component of							
RF #1	RF #2	RF #3	RF #4	RF #5	RF #6	RF #7	RF #8
X	y	z	x	y	z	x	y

As noted from the above tables, components are repeated in the pattern of x, y, z, x, y, z, for TTIs = 10ms and 40ms, whereas components are repeated in the pattern of x, z, y, x, z, y, for TTIs = 20ms and 80ms.

Given a TTI, the DEMUX 141 demultiplexes 1st-interleaver output in the above-described manner.

Returning to FIG. 2, the DEMUX 141 demultiplexes a radio frame received from the radio frame segmenter 130 into its components x, y, z, according to a switching rule. The switching rule is determined by a TTI and the number of filler bits used by the radio frame segmenter 130 in embodiment 1 and a TTI in embodiments 2 and 3. The components are repeated in a certain pattern. The repeating patterns for the embodiments are tabulated in Tables 15 and 16. In the tables, N/A indicates "not applicable".

(Table 15)

For embodiment 1

TTI	total number of filler bits	switching rules (repeating patterns)							
		RF #1	RF #2	RF #3	RF #4	RF #5	RF #6	RF #7	RF #8
10ms	0	x, y, z	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20ms	0, 1	x, z, y	y, x, z	N/A	N/A	N/A	N/A	N/A	N/A
40ms	0, 1, 3	x, y, z	z, x, y	y, z, x	x, y, z	N/A	N/A	N/A	N/A
	2	x, y, z	z, x, y	z, x, y	x, y, z	N/A	N/A	N/A	N/A
80ms	0, 1, 7	x, z, y	y, x, z	z, y, x	x, z, y	y, x, z	z, y, x	x, z, y	y, x, z
	2, 3	x, z, y	y, x, z	z, y, x	x, z, y	x, z, y	y, x, z	z, y, x	y, x, z
	4	x, z, y	y, x, z	y, x, z	z, y, x	z, y, x	y, x, z	z, y, x	y, x, z
	5, 6	x, z, y	y, x, z	y, x, z	z, y, x	x, z, y	z, y, x	x, z, y	y, x, z

(Table 16)

For embodiments 2 and 3

TTI	switching rules (repeating patterns)							
	RF #1	RF #2	RF #3	RF #4	RF #5	RF #6	RF #7	RF #8
10ms	x, y, z	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20ms	x, z, y	y, x, z	N/A	N/A	N/A	N/A	N/A	N/A
40ms	x, y, z	z, x, y	y, z, x	x, y, z	N/A	N/A	N/A	N/A
80ms	x, z, y	y, x, z	z, y, x	x, z, y	y, x, z	z, y, x	x, z, y	y, x, z

If two filler bits are used for TTI = 40ms in embodiment 1, the switching

patterns in the DEMUX 141 are x, y, z, x, y, z for the first radio frame, z, x, y, z, x, y for the second radio frame, z, x, y, z, x, y for the third radio frame, and x, y, z, x, y, z for the fourth radio frame.

Only if the initial component of each radio frame is given, the control operation is more simplified since the repeating patterns are preset. To do so, tables 17 and 18 can be made out.

(Table 17)

For embodiment 1

TTI	total number of filler bits	initial component of							
		RF #1	RF #2	RF #3	RF #4	RF #5	RF #6	RF #7	RF #8
10ms	0	x	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20ms	0, 1	x	y	N/A	N/A	N/A	N/A	N/A	N/A
40ms	0, 1, 3	x	z	y	x	N/A	N/A	N/A	N/A
	2	x	z	z	x	N/A	N/A	N/A	N/A
80ms	0, 1, 7	x	y	z	x	y	z	x	y
	2, 3	x	y	z	x	x	y	z	y
	4	x	y	y	z	z	y	z	y
	5, 6	x	y	y	z	x	z	x	y

(Table 18)

For embodiments 2 and 3

TTI	initial component of							
	RF #1	RF #2	RF #3	RF #4	RF #5	RF #6	RF #7	RF #8
10ms	x, y, z	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20ms	x, z, y	y, x, z	N/A	N/A	N/A	N/A	N/A	N/A
40ms	x, y, z	z, x, y	y, z, x	x, y, z	N/A	N/A	N/A	N/A
80ms	x, z, y	y, x, z	z, y, x	x, z, y	y, x, z	z, y, x	x, z, y	y, x, z

(Table 19)

Repeating Patterns

TTI	repeating patterns
10ms, 40ms	..., x, y, z, x, y, z, ...
20ms, 80ms	..., x, z, y, x, z, y, ...

Referring to FIG. 2 again, the MUX 145 multiplexes three streams received from the component rate matchers 142, 143, and 144 to one stream, to thereby generate a rate-matched radio frame with the same component pattern as before rate matching. Because this MUX 145 is the counterpart of the DEMUX 141, it switches according to the same switching patterns.

FIG. 11 is a block diagram of a DEMUX and MUX controlling apparatus according to embodiment 1-1 of the present invention.

Referring to FIG. 11, upon receipt of a TTI a filler bit number and a radio frame length from the host 200, the controller 210 feeds the TTI, the filler bit number, and the index of a current radio frame to the memory 220 (see Table 17) and receives the initial component of the current radio frame from the memory 220. Then, the controller 210 controls the switching operations of the DEMUX 141 and the MUX 145 based on the initial component and a repeating pattern determined by the TTI. The DEMUX 141 separates the current radio frame into components and the MUX 145 multiplexes rate-matched components to a radio frame in its original arrangement.

FIG. 12 is a block diagram of a DEMUX and MUX controlling apparatus according to embodiment 1-2 of the present invention.

Referring to FIG. 12, upon receipt of a TTI and a radio frame length from the host 200, the controller 210 feeds the TTI, a filler bit number, and the index

of a current radio frame to the memory 220 (see Table 17) and receives the initial component of the current radio frame from the memory 220. The number of filler bits is determined based on the TTI and the frame length inside the controller 210 in the same manner as used in the radio frame segmenter. Then, the controller 210 controls the switching operations of the DEMUX 141 and the MUX 145 based on the initial component and a repeating pattern determined by the TTI. The DEMUX 141 separates the current radio frame into components and the MUX 145 multiplexes rate-matched components to a radio frame in its original arrangement.

FIG. 13 is a block diagram of a DEMUX and MUX controlling apparatus according to embodiments 2 and 3 of the present invention.

Referring to FIG. 13, upon receipt of a TTI and a radio frame length from the host 200, the controller 210 feeds the TTI and the index of a current radio frame to a memory 220 (see Table 18) and receives the initial component of the current radio frame from the memory 220. Then, the controller 210 controls the switching operations of the DEMUX 141 and the MUX 145 based on the initial component and a repeating pattern determined by the TTI. The DEMUX 141 separates the current radio frame into components and the MUX 145 multiplexes rate-matched components to a radio frame in its original arrangement.

[EFFECTS OF THE INVENTION]

As described above, the present invention proposes an apparatus and method for controlling a DEMUX and a MUX provided for rate matching in a uplink transmitting device of a radio communication system. The present invention can increase data transmission efficiency and system performance by

performing a rate matching operation through the apparatus and method.

[PATENT CLAIMS]

1. An uplink transmitting device in a radio communication system, comprising:

a turbo encoder for turbo-encoding data for transmission and outputting encoded symbols;

an interleaver for interleaving the encoded symbols;

a radio frame segmenter for segmenting the interleaved symbols into a radio frame of a predetermined unit;

a demultiplexer for demultiplexing the radio frame according to a predetermined rule;

rate matchers for rate-matching radio frames separately outputted from the demultiplexer; and

a multiplexer for multiplexing an output of the rate matchers according to the predetermined rule to output a multiplexed frame.

2. The transmitting device of claim 1, wherein the predetermined rule relates to the output pattern of the interleaver and the radio frame segmenter.

3. The transmitting device of claim 1, wherein the predetermined rule is determined based on an initial component value of a present frame outputted from the radio frame segmenter and a repeating pattern determined by a transmission time unit.

4. The transmitting device of claim 3, wherein the demultiplexer outputs an initial bit of a radio frame outputted from the radio frame segmenter to a rate matcher corresponding to the initial component value, and outputs the following bits to corresponding rate matchers according to the repeating pattern.

5. The transmitting device of claim 3, wherein the multiplexer receives a rate-matched bit from a rate matcher corresponding to the initial component value, and receives the following bits from rate matchers corresponding to the repeating pattern to multiplex the received bits.

6. An uplink transmitting device in a radio communication system, comprising:

a turbo encoder for turbo-encoding data for transmission and outputting encoded symbols;

an interleaver for interleaving the encoded symbols;

a radio frame segmenter for segmenting the interleaved symbols into a radio frame of a predetermined unit;

a demultiplexer for demultiplexing the radio frame;

rate matchers for rate-matching radio frames separately outputted from the demultiplexer;

a multiplexer for multiplexing an output of the rate matchers to output a multiplexed frame.

a memory for storing an initial component value of a present radio frame corresponding to the number of radio frames; and

a controller for calculating a presently-generated radio frame's number by receiving information on radio frame length and a transmission time unit, receiving from the memory an initial component value corresponding to the calculated number, and controlling the demultiplexer and the multiplexer according to a repeating pattern determined by the received initial component value and the transmission time unit.

7. The transmitting device of claim 6, wherein the radio frame

segmenter uses a filler bit when generating the radio frame of the predetermined unit.

8. The transmitting device of claim 7, wherein the turbo encoder inserts a filler bit into the encoded symbols when generating the radio frame of the predetermined unit.

9. A method for controlling a demultiplexer and a multiplexer in a radio communication system that includes the demultiplexer, a plurality of rate matchers and the multiplexer for rate matching, the method comprising the steps of:

turbo-encoding data for transmission and outputting encoded symbols;

interleaving the encoded symbols;

segmenting the interleaved symbols into a radio frame of a predetermined unit;

demultiplexing the radio frame according to a predetermined rule;

rate-matching radio frames separately outputted from the demultiplexer; and

multiplexing an output of the rate matchers according to the predetermined rule to output a multiplexed frame.

10. The method of claim 9, wherein the predetermined rule relates to the output pattern determined according to the results of the interleaving and the radio frame segmentation.

11. The method of claim 9, wherein the predetermined rule is determined based on an initial component value of a presently-generated radio frame and a repeating pattern determined by a transmission time unit.

12. The method of claim 11, wherein the demultiplexing step comprises the steps of outputting an initial bit of the generated radio frame to a rate matcher corresponding to the initial component value and outputting the following bits to corresponding rate matchers according to the repeating pattern.

13. The method of claim 11, wherein the multiplexing step comprises the steps of receiving a rate-matched bit from a rate matcher corresponding to the initial component value and receiving the following bits from rate matchers corresponding to the repeating pattern to multiplex the received bits.

14. The method of claim 9, wherein a filler bit for generating the radio frame of the predetermined unit is inserted into the encoded symbols.

15. The method of claim 9, wherein a filler bit for generating the radio frame of the predetermined unit is inserted into the radio frame.

[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

Disclosed is an apparatus and method for controlling a demultiplexer and multiplexer provided for rate matching in a radio communication system. An uplink transmitter according to the present invention comprises: a turbo encoder for turbo-encoding data for transmission and outputting encoded symbols; an interleaver for interleaving the encoded symbols; a radio frame segmenter for segmenting the interleaved symbols into radio frames of a predetermined unit; a demultiplexer for demultiplexing the radio frames according to a predetermined rule; rate matchers for rate-matching radio frames separately outputted from the delultiplexer and outputting rate-matched frames; and a multiplexer for multiplexing an output of the rate matchers according to the predetermined rule and outputting a multiplexed frame. The above rule is determined based on an initial component value of a present frame outputted from the radio frame segmenter and a repeating pattern determined by a transmission time unit.

[REPRESENTATIVE FIGURE]

FIG. 11

[INDEX]

Rate Matching, Demultiplexer, Multiplexer, Output Pattern, Initial Component, and Repeating Pattern

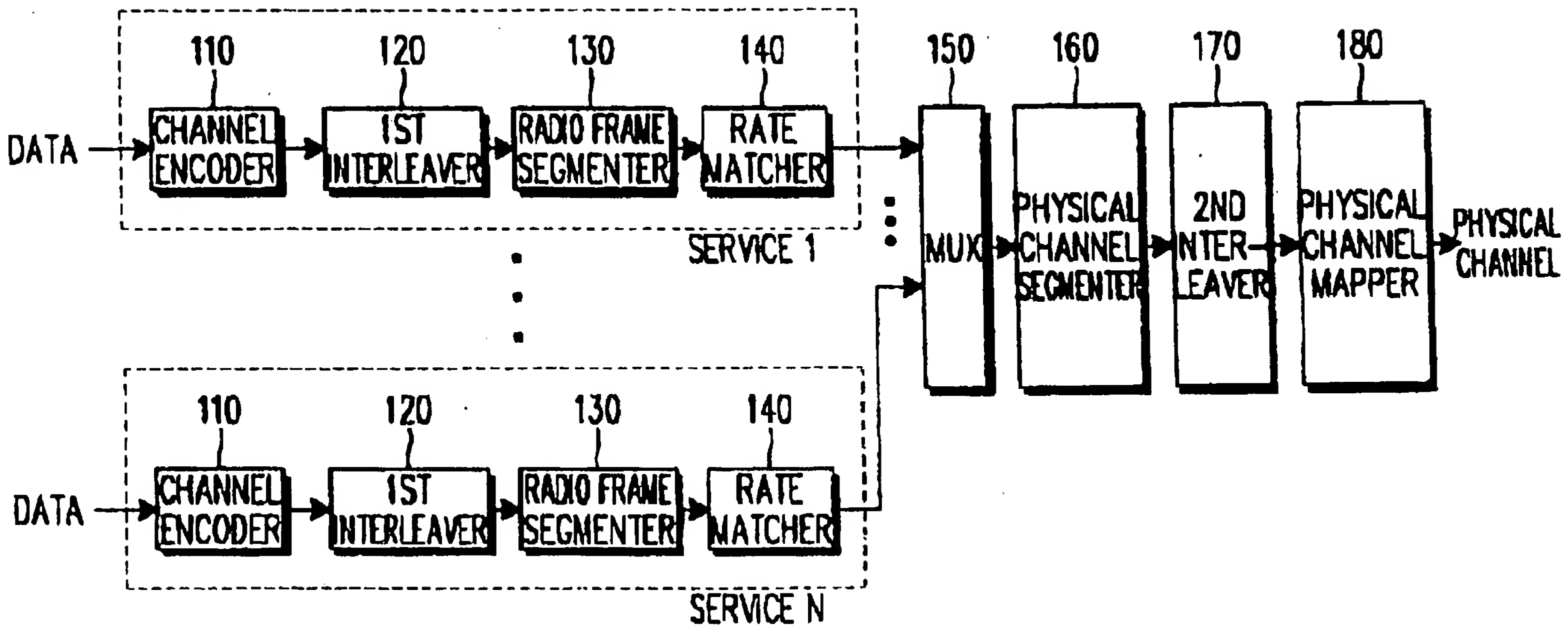

DATA
110
CHANNEL ENCODER
120
1ST INTERLEAVER
130
RADIO FRAME SEGMENTER
140
RATE MATCHER
SERVICE 1
DATA
110
CHANNEL ENCODER
120
1ST INTERLEAVER
130
RADIO FRAME SEGMENTER
140
RATE MATCHER
SERVICE N
150
MUX
160
PHYSICAL CHANNEL SEGMENTER
170
2ND INTER-LEAVER
180
PHYSICAL CHANNEL MAPPER
PHYSICAL CHANNEL

FIG.1

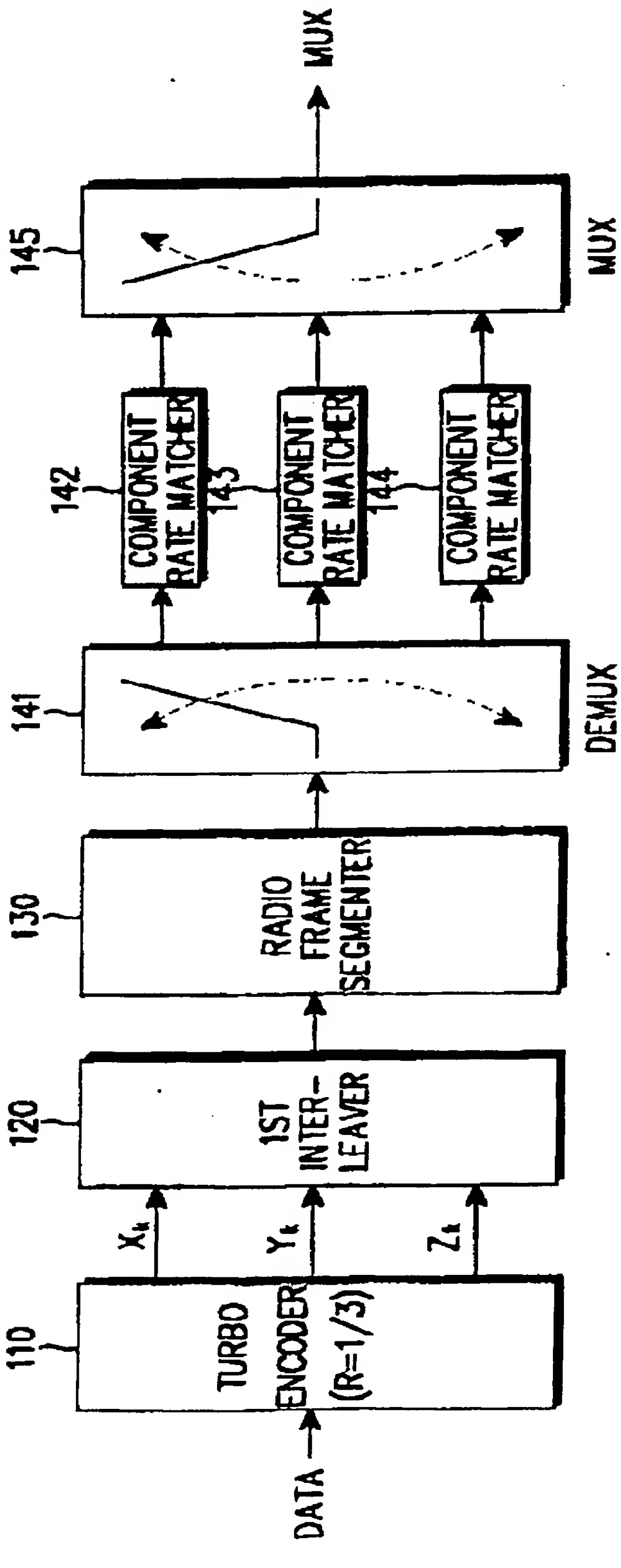

DATA
TURBO ENCODER (R=1/3)
110
Xk
Yk
Zk
1ST INTER-LEAVER
120
RADIO FRAME SEGMENTER
130
141
DEMUX
142
143
144
COMPONENT RATE MATCHER
COMPONENT RATE MATCHER
COMPONENT RATE MATCHER
145
MUX
MUX

FIG.2

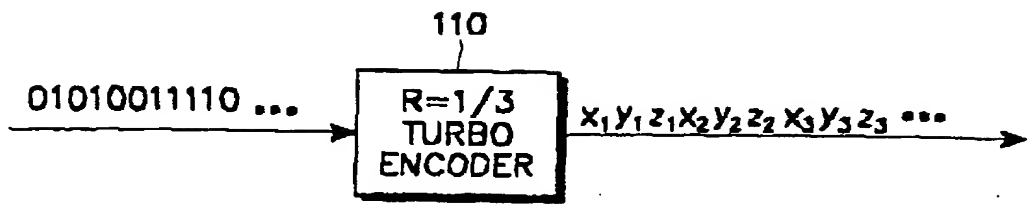


FIG.3

1st INTERLEAVER INPUT(CODE RATE R=1/3)

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64
65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96
97	98	99	100	101	102	103	104
105	106	107	108	109	110	111	112
113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128
129	130	131	132	133	134	135	136
137	138	139	140	141	142	143	144
145	146	147	148	149	150	151	152
153	154	155	156	157	158	159	160

FIG.4

AFTER TTI=20msec INTERLEAVING(CODE RATE R=1/3)

1	3	5	7	9	11	13	15
17	19	21	23	25	27	29	31
33	35	37	39	41	43	45	47
49	51	53	55	57	59	61	63
65	67	69	71	73	75	77	79
81	83	85	87	89	91	93	95
97	99	101	103	105	107	109	111
113	115	117	119	121	123	125	127
129	131	133	135	137	139	141	143
145	147	149	151	153	155	157	159
2	4	6	8	10	12	14	16
18	20	22	24	26	28	30	32
34	36	38	40	42	44	46	48
50	52	54	56	58	60	62	64
66	68	70	72	74	76	78	80
82	84	86	88	90	92	94	96
98	100	102	104	106	108	110	112
114	116	118	120	122	124	126	128
130	132	134	136	138	140	142	144
146	148	150	152	154	156	158	160

FIG.5A

AFTER TTI=40msec INTERLEAVING(CODE RATE R=1/3)

1	5	9	13	17	21	25	29
33	37	41	45	49	53	57	61
65	69	73	77	81	85	89	93
97	101	105	109	113	117	121	125
129	133	137	141	145	149	153	157
3	7	11	15	19	23	27	31
35	39	43	47	51	55	59	63
67	71	75	79	83	87	91	95
99	103	107	111	115	119	123	127
131	135	139	143	147	151	155	159
2	6	10	14	18	22	26	30
34	38	42	46	50	54	58	62
66	70	74	78	82	86	90	94
98	102	106	110	114	118	122	126
130	134	138	142	146	150	154	158
4	8	12	16	20	24	28	32
36	40	44	48	52	56	60	64
68	72	76	80	84	88	92	96
100	104	108	112	116	120	124	128
132	136	140	144	148	152	156	160

FIG.5B

AFTER TTI =80msec INTERLEAVING(CODE RATE R=1/3)

1	9	17	25	33	41	49	57
65	73	81	89	97	105	113	121
129	137	145	153	5	13	21	29
37	45	53	61	69	77	85	93
101	109	117	125	133	141	149	157
3	11	19	27	35	43	51	59
67	75	83	91	99	107	115	123
131	139	147	155	7	15	23	31
39	47	55	63	71	79	87	95
103	111	119	127	135	143	151	159
2	10	18	26	34	42	50	58
66	74	82	90	98	106	114	122
130	138	146	154	6	14	22	30
38	46	54	62	70	78	86	94
102	110	118	126	134	142	150	158
4	12	20	28	36	44	52	60
68	76	84	92	100	108	116	124
132	140	148	156	8	16	24	32
40	48	56	64	72	80	88	96
104	112	120	128	136	144	152	160

FIG.5C

TTI = 10msec

RF
x
y
z
x
y
z
...

FIG.6A

TTI = 20msec

RF1	RF2
x	y
z	x
y	z
x	y
z	x
y	z
...	...

FIG.6B

TTI = 40msec

RF1	RF2	RF3	RF4
x	z	y	x
y	x	z	y
z	y	x	z
x	z	y	x
y	x	z	y
z	y	x	z
⋮	⋮	⋮	⋮

FIG.6C

TTI = 80msec

RF1	RF2	RF3	RF4	RF5	RF6	RF7	RF8
x	y	z	x	y	z	x	y
z	x	y	z	x	y	z	x
y	z	x	y	z	x	y	z
x	y	z	x	y	z	x	y
z	x	y	z	x	y	z	x
y	z	x	y	z	x	y	z
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

FIG.6D

1ST INTERLEAVER INPUT WHEN TTI = 80msec

x	y	z	x	y	z	x	y
z	x	y	z	x	y	z	x
y	z	x	y	z	x	y	z
x	y	z	x	y	z	x	y
z	x	y	z				

FIG.7A

1ST INTERLEAVER OUTPUT

x	y	z	x	y	z	x	y
z	x	y	z	x	y	z	x
y	z	x	y	z	x	y	z
x	y	z	x	y	z	x	y
z		y		x		z	

FIG.7B

RADIO FRAME SEGMENTER OUTPUT (WITH FILLER BITS INSERTED)

RF1	RF2	RF3	RF4	RF5	RF6	RF7	RF8
x	y	y	z	z	y	z	y
z	x	x	y	y	x	y	x
y	z	z	x	x	z	x	z
x	y	y	y	z	x	z	y
z	z	x	x	0	0	0	0

FIG.7C

1ST INTERLEAVER INPUT WHEN TTI = 40msec

x	y	z	x
y	z	x	y
z	x	y	z
x	y	z	x
y	z	x	y
z			

FIG.8A

1ST INTERLEAVER OUTPUT

x	z	y	x
y	x	z	y
z	y	x	z
x	z	y	x
y	x	z	y
z			

FIG.8B

RADIO FREAME SEGMENTER OUTPUT (WITH FILLER BITS INSERTED)

RF1	RF2	RF3	RF4
x	z	y	x
y	x	z	y
z	y	x	z
x	z	y	x
y	x	z	y
z	0	0	0

FIG.8C

1ST INTERLEAVER INPUT WHEN TTI = 80msec

x	y	z	x	y	z	x	y
z	x	y	z	x	y	z	x
y	z	x	y	z	x	y	z
x	y	z	x	y	z	x	y
z	x	y	z				

FIG.9A

1ST INTERLEAVER OUTPUT

x	y	z	x	y	z	x	y
z	x	y	z	x	y	z	x
y	z	x	y	z	x	y	z
x	y	z	x	y	z	x	y
z		y		x		z	

FIG.9B

FIRST INTERLEAVER OUTPUT (WITH FILLER BITS INSERTED)

x	y	z	x	y	z	x	y
z	x	y	z	x	y	z	x
y	z	x	y	z	x	y	z
x	y	z	x	y	z	x	y
z	0	y	0	x	0	z	0

FIG.9C

RADIO FRAME SEGMENTER OUTPUT

x	y	z	x	y	z	x	y
z	x	y	z	x	y	z	x
y	z	x	y	z	x	y	z
x	y	z	x	y	z	x	y
z	0	y	0	x	0	z	0

FIG.9D

1ST INTERLEAVER INPUT WHEN TTI = 80msec

x	y	z	x	y	z	x	y
z	x	y	z	x	y	z	x
y	z	x	y	z	x	y	z
x	y	z	x	y	z	x	y
z	x	y	z				

FIG.10A

1ST INTERLEAVER OUTPUT

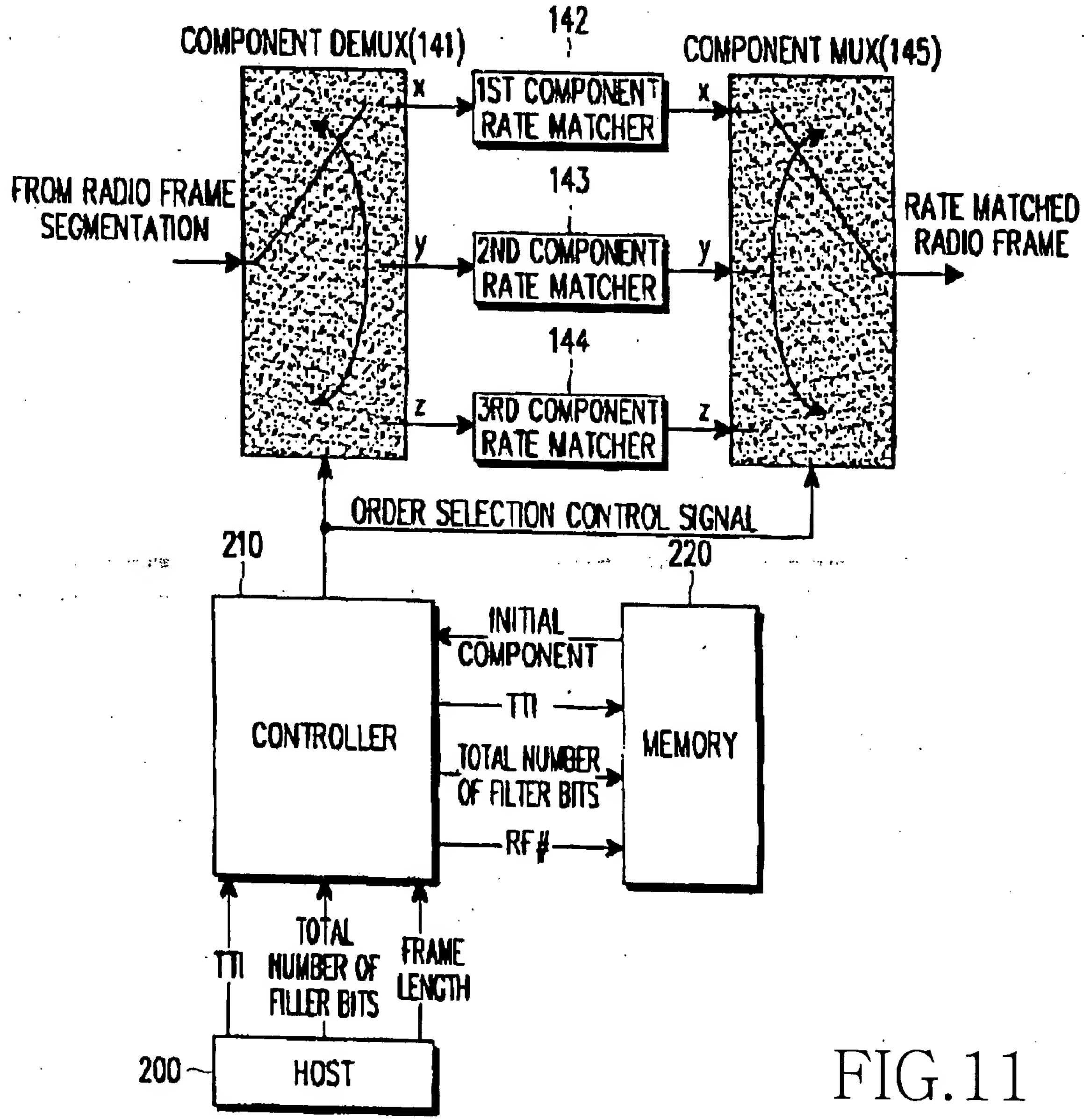
x	y	z	x	y	z	x	y
z	x	y	z	x	y	z	x
y	z	x	y	z	x	y	z
x	y	z	x	y	z	x	y
z		y		x		z	

FIG.10B

RADIO FRAME SEGMENTER OUTPUT

RF1	RF2	RF3	RF4	RF5	RF6	RF7	RF8
x	y	z	x	y	z	x	y
z	x	y	z	x	y	z	x
y	z	x	y	z	x	y	z
x	y	z	x	y	z	x	y
z	0	y	0	x	0	z	0

FIG.10C



COMPONENT DEMUX(141)
142
COMPONENT MUX(145)
x
1ST COMPONENT RATE MATCHER
x
FROM RADIO FRAME SEGMENTATION
143
RATE MATCHED RADIO FRAME
y
2ND COMPONENT RATE MATCHER
y
144
z
3RD COMPONENT RATE MATCHER
z
ORDER SELECTION CONTROL SIGNAL
210
220
INITIAL COMPONENT
CONTROLLER
TTI
MEMORY
TOTAL NUMBER OF FILTER BITS
RF#
TTI
TOTAL NUMBER OF FILLER BITS
FRAME LENGTH
200
HOST

FIG.11

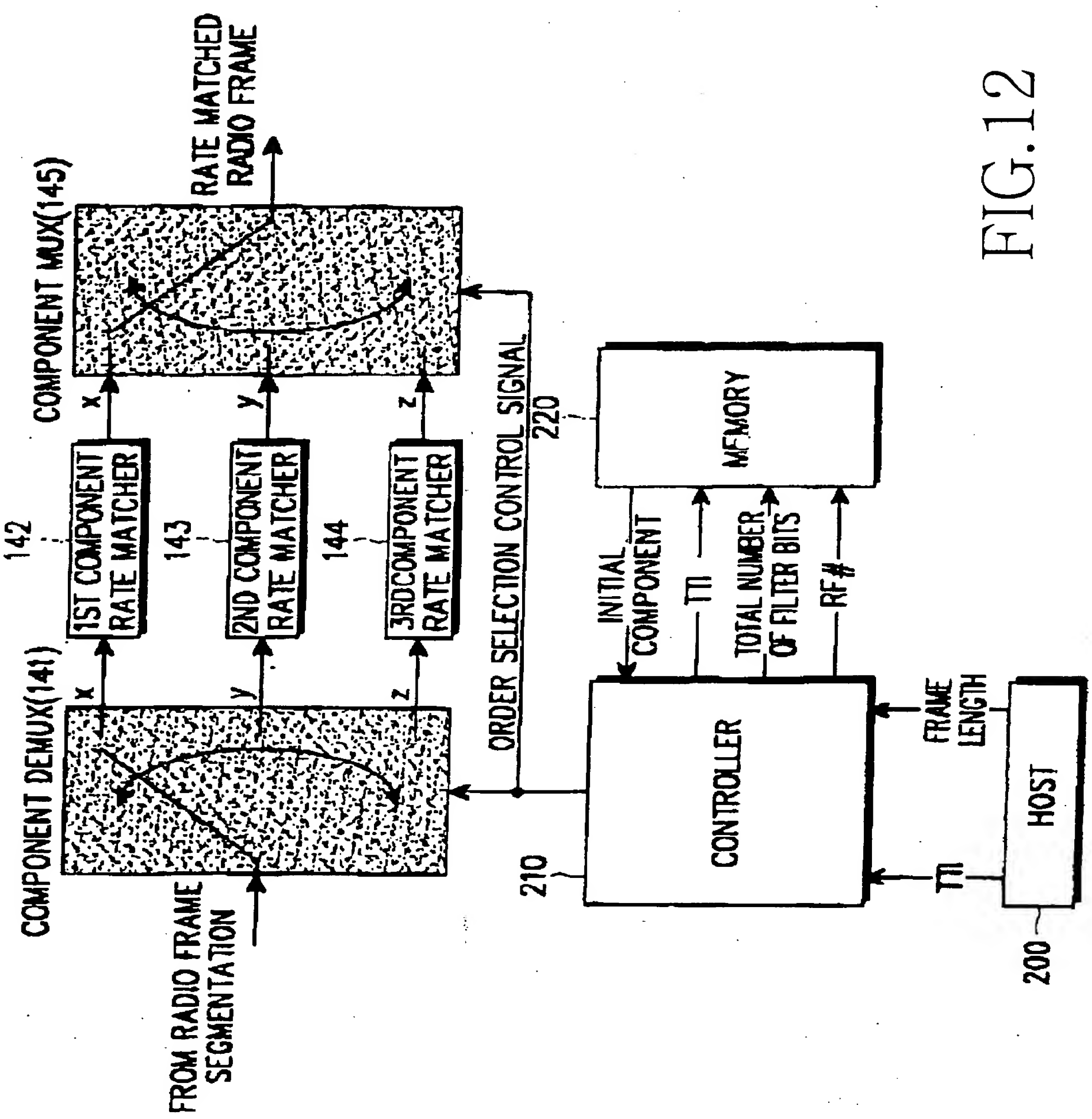

COMPONENT DEMUX(141)
FROM RADIO FRAME SEGMENTATION
x
y
z
142
1ST COMPONENT RATE MATCHER
143
2ND COMPONENT RATE MATCHER
144
3RDCOMPONENT RATE MATCHER
COMPONENT MUX(145)
RATE MATCHED RADIO FRAME
ORDER SELECTION CONTROL SIGNAL
220
MEMORY
INITIAL COMPONENT
TTI
TOTAL NUMBER OF FILTER BITS
RF#
210
CONTROLLER
FRAME LENGTH
TTI
HOST
200

FIG.12

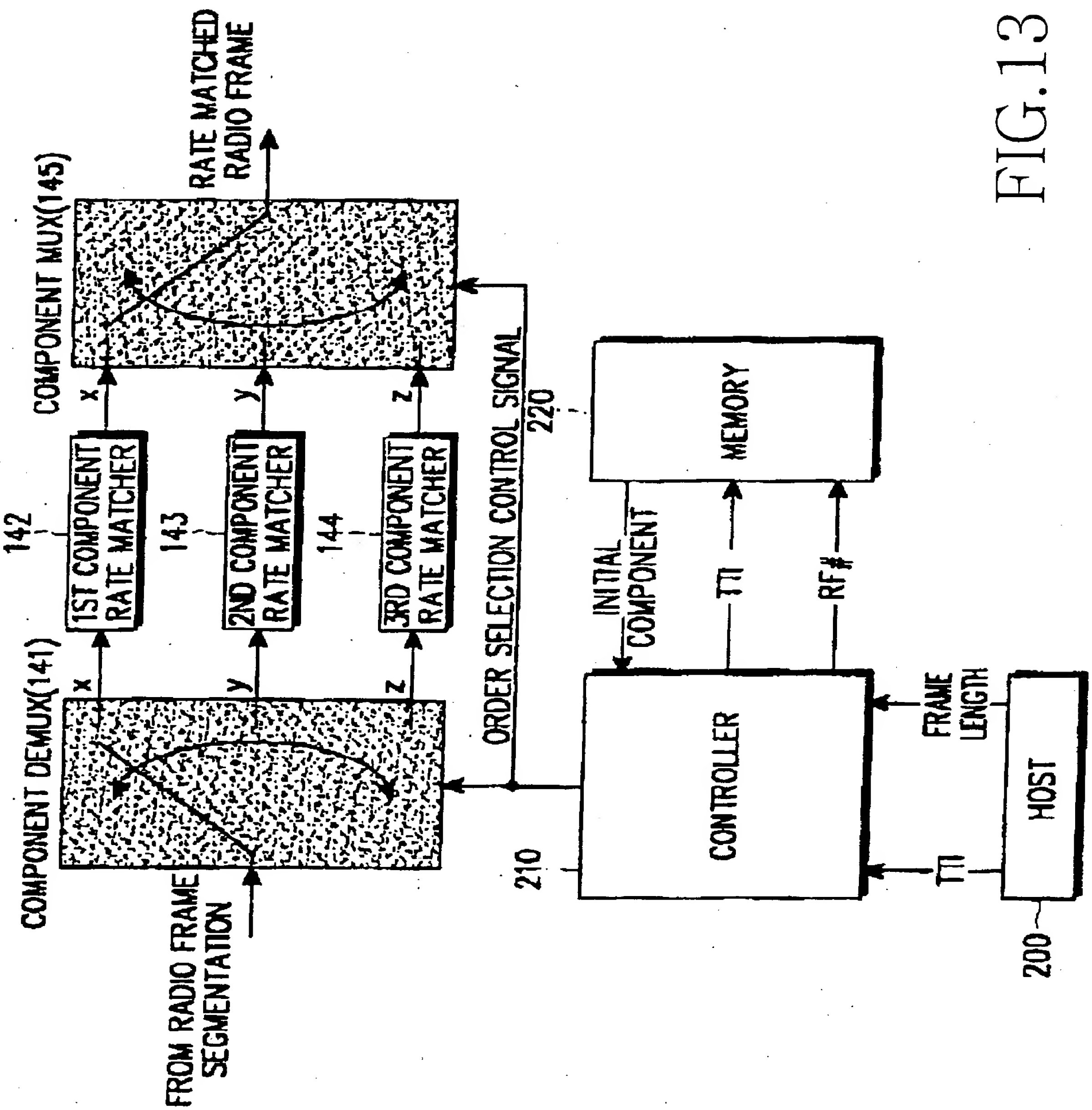

FROM RADIO FRAME SEGMENTATION
COMPONENT DEMUX(141)
x
y
z
142
1ST COMPONENT RATE MATCHER
143
2ND COMPONENT RATE MATCHER
144
3RD COMPONENT RATE MATCHER
x
y
z
COMPONENT MUX(145)
RATE MATCHED RADIO FRAME
ORDER SELECTION CONTROL SIGNAL
220
MEMORY
INITIAL COMPONENT
TTI
RF#
210
CONTROLLER
FRAME LENGTH
TTI
HOST
200

FIG.13